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NEW FUNGICIDES and the CONTROL of CELERY BLIGHTS

J. D. Wilson

OHIO AGRICULTURAL EXPERIMENT STATION
WOOSTER, OHIO

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Experiments on the control of celery blights, of which there are three in this state, have been in progress for over 30 years in Ohio. The so-called early blight (Cercospora) of celery, as distinguished from late blight (Septoria) is actually a misnomer, since it may, as it did in 1958, occur later in the season in any given year than does late blight. Bacterial blight is much less common in Ohio than the other two forms, although it did appear in several fields in 1958, where it was found to be very difficult to control with any of the fungicides now available.

Beginning in the mid-twenties, experiments were initiated at Celeryville, Ohio, in which the then new copper-lime dust was being compared with Bordeaux mixture for the control of early and/or late blights of celery. A comparatively good control recommendation was worked out and recommended to the growers in a bulletin[1] published in 1930, to the effect that celery should be sprayed with a 5-5-50 Bordeaux mixture or dusted with a 20-80 copper-lime dust at approximately weekly intervals throughout the growth period of the crop, including a treatment in the seed bed.

As time went it was found that these two celery blights still caused a very considerable loss if a treatment interval of 7 to 10 days was not carefully observed. This suggested that a study of the relationship between the length of the spray interval and the degree of disease control obtained should be made. This was done in a series of experiments on the State Muck Farm, then located at McGuffey, Ohio, in 1934 to 1941 in connection with comparative tests between the then newly introduced fixed coppers and Bordeaux mixture. Most of the recommendations for the control of the foliage diseases of vegetables suggest the use of a spray interval of 7 to 10 days, but it was found that "sprays applied every 6 days struck a favorable balance between the injury caused by applications made every 4 days and the insufficient degree of disease control furnished by the 8-day interval"[2].

1/ Wilson, J. D. and A. G. Newhall. 1930. The control of celery blights. Ohio Agr. Exp. Sta. Bull. 461: 1-30.

2/ Wilson, J. D. 1944. The control of celery blights with Bordeaux, the fixed coppers with and without sulfur, and Fermate. Ohio Agr. Exp. Sta. Bimo. Bull. 31: 95-109.

These experiments of the late thirties indicated that any one of several fixed copper compounds could, and probably would, give good control of celery blights without the chance of plant injury that often accompanied the use of Bordeaux mixture. Thus, by 1940, the blight control recommendations had been expanded to include the use of such materials as Copper A, COC-S, and Tribasic applied on a 6-day schedule. This use of the fixed coppers had no more than become well established before the first of the dithiocarbamates, a group of organic fungicides that were destined to play nearly as important a role in the control of vegetable diseases as were the chlorinated hydrocarbons (DDT and others) and the organic phosphates (Thimet and others) in the control of insects, was introduced under the trade name of Fermate. Experiments conducted in 1942 and 1943, and reported in the above mentioned Bimonthly Bulletin[2], indicated that Fermate was at least the equal of Bordeaux mixture and the best of the fixed coppers in the control of celery blights.

Other dithiocarbamates later to be known under the trade names of Dithane Z-78, Parzate, and Zerlate came into the experimental picture in the mid-forties, and Zerlate in particular was recommended for use on celery in Ohio about 1946. During this same year another member of this now famous group of fungicides (the dithiocarbamates) was introduced as an experimental compound. It soon became known under the common name of maneb, and the trade names of Manzate and Dithane M-22. It was specifically recommended for use on celery in Ohio in 1955 after experiments conducted from 1946 to 1954 had demonstrated its usefulness for that purpose[3]. Now a few years later still another organic fungicide designated as Dyrene (2,4-dichloro-6-(O-chloroanilino) triazine has been added to the list of treatments capable of giving a high degree of control of these foliage diseases of celery.

In 1957, several newly developed fungicides were compared with most of those mentioned above in an experiment on celery being grown at the Muck Experiment Station at Celeryville[4]. The yield and disease control data obtained are given in Table 1. Early blight (Cercospora apii) became very severe before the celery was ready for

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3/ Wilson, J. D. 1955. Maneb gives best control of early blight on celery. Ohio Agr. Exp. Sta., Farm and Home Res. 40(206): 83,84 & 86.

4/ Wilson, J. D. 1958. Experiments in the control of vegetable diseases in Ohio conducted in 1957. Ohio Agr. Exp. Sta., Bot. and Plant Path., Mimeo Series No. 26: 1-82.

Table 1. The control of early blight of celery by various recommended and experimental fungicides at Celeryville in 1957.

Treatments		Trimmed yield T/A	Blighted leaves per 100 ft. of row	Percent of foliage dead on Sept. 10
1. Manzate	2-100	34.5	1100	27
2. Zerlate	2-100	32.3	920	27
3. Parzate	2-100	30.8	1020	32
4. Phaltan	3-100	39.7	720	30
5. Dyrene	2-100	43.7	320	30
6. Thioneb 50-W	2-100	35.9	830	25
7. Captan 50-W	3-100	28.0	1330	47
8. Omadine Zinc	2-100	31.2	1130	35
9. Cop-O-Zinc	4-100	32.6	1040	35
10. Tribasic	4-100	35.9	1300	35
11. Zinc oxide	4-100	24.2	2590	62
12. None	- - -	15.9	3000	77
L.S.D. at 5% level =		3.9		

harvest with the result that the plants in the unsprayed check plots were nearly destroyed. Dyrene, a comparative newcomer in the list of vegetable fungicides, gave the best control of the disease on the foliage and the highest yield of the experiment. Phaltan and Thioneb also gave very good results in terms of yield and disease control. Manzate and Zerlate gave good control of defoliation but the plots treated with them did not yield quite as well as some of the others. Tribasic gave a good yield but did not check early blight as well as many of the organic fungicides. Zinc oxide caused considerable foliage injury, with a resultant low yield.

In 1958, a similar planting of celery that was severely attacked by late blight (Septoria apii), with early blight very scarce, was sprayed with some of the same fungicides that were used in 1957. The data for this experiment are given in Table 2 and the five fungicides that repeat from 1957 are those listed as Treatments 6 to 10, inclusive.

Table 2. The comparative control of late blight of celery by various oils, fungicides, and oil-fungicide formulations at Celeryville in 1958.

Treatments and Formulas		Trimmed yield Tons/Acre	Percent foliage dead on Sept. 12
1. None	- - -	17.7	60
2. Soybean oil	1-100	19.2	55
3. ML-100A oil	1-100	31.4	37
4. Sun 88819-X oil	1-100	31.9	37
5. Orthocide 80	1.5-100	37.5	17
6. Dyrene	2-100	45.4	12
7. Zerlate	2-100	37.0	19
8. Tribasic	4-100	32.9	18
9. Manzate	2-100	39.2	14
10. Phaltan	2-100	37.0	13
11. Phaltan + Sticker	2-0.5-100	37.7	19
12. Phaltan + ML-100A	2-1-100	47.5	10
13. Manzate + ML-100A	2-1-100	48.7	14
14. Dyrene + ML-100A	2-1-100	48.9	12
15. Zerlate + ML-100A	2-1-100	49.2	13
16. Tribasic + ML-100A	4-1-100	48.8	15

Of these Dyrene again gave the best disease control and the highest yield (See Figure 1). Manzate and Phaltan also gave very good control of late blight infection, although the yields were not as high as with Dyrene. Thus, since Dyrene gave better control of early blight in 1957 than any one of several fungicides that are currently being recommended and repeated this performance against late blight in 1958, it will now be added to the list of materials being recommended in Ohio for the control of these two most common foliage diseases of celery.

The oils listed in Table 2 were included in the 1958 experiment on the chance that they might give some control of early blight which is present on celery nearly every year at Celeryville. This disease is caused by Cercospora apii Fres., and since a closely related fungus

which causes the Sigatoka disease of banana (Cercospora musae Zimm.) is now being controlled with certain hydrocarbon oils similar to those listed as Treatments 3 and 4 in Table 2, it was thought possible that these oils might also check a fungus of the same genus on celery. However, early blight was comparatively scarce in the 1958 experiment and instead late blight caused by Septoria apii (Br. and Cav.) Rostrup, was the disease that defoliated the unsprayed plants. The two hydrocarbon oils (ML-100A and Sun 88819-X) did give some control of late blight, as is shown by an increased yield over the check plots and a lessened degree of defoliation. One noticeable feature was the fact that the formation of the fruiting bodies of the fungus (pycnidia) was greatly reduced on the leaves of the plants being sprayed with these oils, particularly with Sun 88819-X. Both of the oils caused some injury to the celery foliage at the rate used, and this became progressively greater as the season advanced. Soybean oil (Treatment 2) gave almost no disease control and did not interfere with sporulation of the fungus.

One of the hydrocarbon oils (ML-100A, which is a mixture of two different oils) was used with Phaltan, Manzate, Dyrene, Zerlate, and Tribasic (Treatments 12 to 16, inclusive, in Table 2). The addition of the oil to these fungicides resulted in a slight increase in disease control for three of them and an increase in yield for all five. The extent of these increases is indicated in Table 3.

Oil gave the greatest yield increase when used with Tribasic and the best increase in disease control when added to Zerlate. The increase in yield and disease control was least when the oil was added to Dyrene, the fungicide which gave the best results when used alone (Table 2). The average increase in yield when oil was added to the five fungicides listed was 27 percent, whereas the increased control of defoliation was only 4 percent. This indicates that oil brought about the yield increase that it did by some means other than through improving the fungicidal action of the chemicals with which it was formulated. A possible explanation would seem to be that the oil reduced the water requirement of the plants treated with it and thus made possible a greater growth on the available soil moisture over and above that which took place with the plants treated with the fungicides not formulated with oil, although there were few periods of low soil moisture at Celeryville during the summer of 1958. However, it is not at present anticipated that the application of oil to edible portions of plants such as celery will be recommended for the purpose of controlling disease, but this type of investigation will be continued, especially on the cercospora leaf blights of celery and carrots, in an effort to learn more about the effect of these nonfungicidal oils on disease control.

Table 3. Effect of adding an oil (ML-100A) to five different fungicides in increasing yield and disease control on celery attacked by late blight at Celeryville in 1958 (See Table 2).

Treatments	Yield in Tons per Acre			Percent Control		
	Fungicide alone	Fungicide plus oil	Percent increase due to oil	Fungicide alone	Fungicide plus oil	Percent increase due to oil
1. Manzate	39.2	48.7	24	75	75	0
2. Dyrene	45.4	48.9	8	78	78	0
3. Zerlate	37.0	49.2	33	67	77	10
4. Tribasic	32.9	48.8	48	69	73	4
5. Phaltan	37.0	47.5	28	77	82	5
6. None	17.7	-----	--	--	--	--
Averages of five fungicides	38.3	48.7	27	73	77	4

In conclusion: The data presented here relative to the control of the early and late blights of celery indicate that Dyrene may be capable of giving as good or better control of these two diseases than any of the fungicides recommended for use on celery during the past 25 or more years. Phaltan also gave very good results against early blight but was not quite the equal of Dyrene and Manzate in the control of late blight. Thus, it is suggested that Dyrene and less likely Phaltan should be added to the list of presently recommended fungicides for the control of celery blights. Also, the results obtained when two oils of low phytotoxicity were applied to celery indicate that an effort should be made to more fully determine the role that they may possibly play in improving disease-control practices on vegetable crops.

Figure 1. Late blight on celery. Plant on left sprayed with Dyrene, one on right from the unsprayed check plot. Note dead leaves and rotted petioles on latter.